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(71) Applicant: **DUNLOP MAXFLI SPORTS CORPORATION [US/US]; 728 N. Pleasantburg Drive, Greenville, SC 29607 (US).**

(72) Inventors: **KUTTAPPA, Sanjay, M.; 109 Creekview Drive, Clemson, SC 29631 (US). LEMONS, Lane, D.; 65**

Raleigh Place, Jackson, TN 38305 (US). **STANCZAK, Matthew, B.; 10486 Long Creek Highway, Westminster, SC 29693 (US). WALLACE, George, R.; 103 Catawbah Road, Clemson, SC 29631 (US).**

(74) Agent: **LORUSSO, Anthony, M.; Lorusso & Loud, 440 Commercial Street, Boston, MA 02109 (US).**

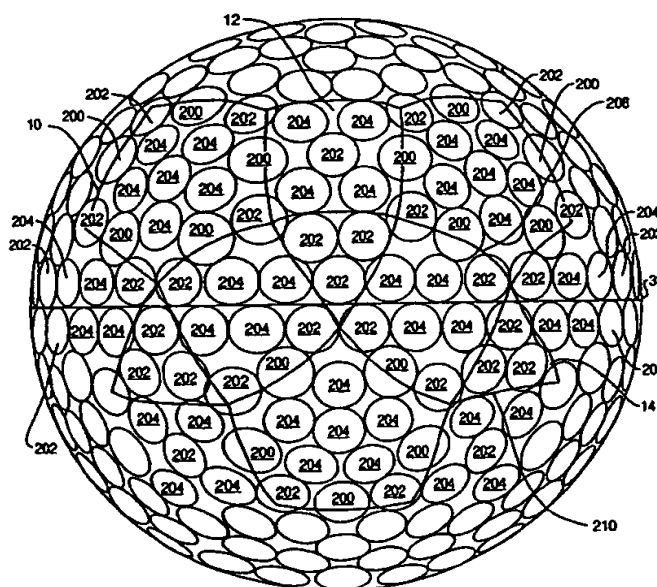
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(54) Title: **LARGE CORE GOLF BALL**



(57) Abstract: A two piece golf ball (5) has a core compression in the range of 77 PGA to 87 PGA, a core diameter in the range of about 1.535 inches to 1.545 inches, a cover hardness in the range of 53 to 59 Shore D, and a dimple pattern based on the geometry of a rhombicosadodecahedron. An uninterrupted equatorial great circle path, corresponding to a mold parting line (30), is provided in the design for forming a cover of the golf ball (5) in two parts. A ball having such characteristics exhibits superior distance performance without compromising shot-making feel.

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1 LARGE CORE GOLF BALL
2
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4 CROSS-REFERENCE TO RELATED APPLIATIONS
5

6 A claim of benefit is made to U.S. Provisional Application Serial No.
7 60/138,079 filed June 8, 1999, the contents of which are incorporated herein by
8 reference. This is a continuation-in-part application of the provisional application
9 filed June 8, 1999, the contents of which are incorporated herein by reference.
10

11 BACKGROUND OF THE INVENTION

12 The instant invention is directed to golf balls, and more particularly to a ball
13 having the optimal core compression, core diameter, cover hardness, and dimple
14 configuration to provide superior playability capabilities with respect to softness
15 and spin without sacrificing superior distance capabilities.
16
17

18 DESCRIPTION OF THE PRIOR ART

19 There are a number of physical properties that affect the performance of a golf
20 ball. The core of the golf ball is the source of the ball's energy. Among other things,
21 the core affects the ball's "feel" and its initial velocity. The "feel" is the overall
22 sensation transmitted to the golfer through the golf ball after striking a ball. The

1 initial velocity is the velocity at which the golf ball travels when first struck by the
2 golf club. The initial velocity, together with the ball's trajectory, determine how far a
3 shot will travel.

4 Until the late 1960's most golf balls were constructed as three-piece wound
5 balls. In the three-piece wound ball, a solid or liquid-filled center is wound with
6 rubber windings to form a core, which is then covered with a cover of compounds
7 based on natural (balata or guttapercha) or synthetic transpolyisoprene. During the
8 manufacturing process, after the liquid-filled center is formed, it is frozen to make it
9 as hard as possible so that it will retain its spherical shape while the rubber thread is
10 wrapped around it.

11 These three-piece wound balls were known and are still known to provide
12 acceptable flight distance and soft feel. Additionally, due to the relative softness of
13 the balata cover, skilled golfers are able to impart various spins on the ball in order to
14 control the ball's flight path (e.g. "fade" or "draw") and check characteristics upon
15 landing on a green.

16 With the advent of new materials developed through advances and
17 experimentation in polymer chemistry, two-piece golf balls were developed. The
18 primary difference between a two-piece golf ball and a three-piece golf ball is the
19 elimination of the rubber thread windings found in the three-piece balls. A relatively

1 large solid core in a two-piece ball takes the place of the relatively small center and
2 thread windings of a three-piece ball core having the same overall diameter. With the
3 elimination of the thread windings, there is no need to freeze the core during the
4 manufacturing process of the two-piece golf ball.

5 Two-piece balls have proven to be more durable than three-piece balls when
6 repeatedly struck with golf clubs and more durable when exposed to a variety of
7 environmental conditions. An example of these environmental conditions is the high
8 temperature commonly experienced in an automobile trunk. In addition, two piece
9 balls are typically less expensive to manufacture than the three-piece wound balls.
10 However, two-piece balls are, in general, considered to have inferior characteristics of
11 feel and workability when compared to three-piece balls. Generally and historically,
12 two piece balls use harder cover materials for increased durability. The "hardness" of
13 a golf ball can affect the "feel" of a ball and the sound or "click" produced at contact.
14 "Feel" is determined as the deformation (i.e. compression) of the ball under various
15 load conditions applied across the ball's diameter. Generally, the lower the
16 compression value, the softer the "feel." Consequently, two-piece golf balls have a
17 higher initial velocity. In addition, typically two-piece golf balls have more potential
18 energy, which is derived primarily from the core. The cores in two piece golf balls are
19 typically larger than the centers in three-piece golf balls.

1 In contrast, three-piece golf balls with their smaller centers historically use
2 softer cover materials. These softer cover materials result in a lower initial velocity
3 when compared to two-piece golf balls. However, this difference in the initial velocity
4 may be somewhat made up by the windings in the three-piece golf ball.

5 In addition to manipulating the core and cover of a golf ball, for many years
6 golf balls have been made with surface indentations or depressions, called dimples, to
7 improve their aerodynamic properties in flight. Specifically, ball manufacturers have
8 looked to dimple configurations in an effort to design a ball with superior distance
9 capabilities. Many efforts have been made to select the optimum number, size and
10 shape of dimples as well as their disposition around the outer surface of a generally
11 spherically shaped golf ball.

12 Ball manufacturers are bound by regulations of the United States Golf
13 Association (USGA) which control many characteristics of the ball, including the
14 size and weight of the ball, the initial velocity of the ball when tested under
15 specified conditions, the overall distance the ball travels when hit under specified
16 test conditions, and the ball's aerodynamic symmetry. Under USGA regulations,
17 the diameter of the ball cannot be less than 1.680 inches, the weight of the ball
18 cannot be greater than 1.620 ounces avoirdupois, the initial velocity of the ball
19 cannot be greater than 250 feet per second when tested under specified conditions

1 (with a maximum tolerance of +2%), the driver distance cannot exceed 280 yards
2 when tested under specified conditions (with a test tolerance of +6%), and the ball
3 must perform the same aerodynamically regardless of orientation.

4 While the USGA sets a limit for the distance a ball can travel under set test
5 conditions, there is no upper limit on how far a player can hit a ball. For example,
6 U.S. Patent No. 4,886,277 discloses the projection of a truncated octahedron onto
7 the ball as a basis for a dimple configuration. A truncated octahedron is formed by
8 removing portions of the eight-sided octahedron, which results in a solid with six (6)
9 squares, and eight (8) hexagons. The preferred ball disclosed in this reference has a
10 minimum of four (4) uninterrupted great circle paths present on the dimpled ball,
11 and a major portion of the dimples present on the ball are within the boundaries of
12 either a spherical hexagon or square. U.S. Patent No. 4,765,626 discloses a golf
13 ball having a dimple pattern based on the truncated octahedron used in conjunction
14 three orthogonal uninterrupted parting lines which coincide with the diagonal
15 bisectors of the squares.

16 A problem with the prior art dimple configurations is that they fail to take
17 into account other features of the ball, such as core size, core compression and cover
18 hardness, which also influence how far a ball will travel.

1 U.S. Patent No. 5,368,304 to Sullivan discloses a ball having a low spin rate,
2 which in turn enables the ball to travel greater distances. According to the Sullivan
3 patent, the low spin rate is the result of a soft core and hard cover. While the '304
4 patent discloses the use of a soft core and hard cover to lower the spin rate, it does
5 not disclose a dimple configuration for the ball.

6 7 OBJECT OF THE INVENTION

8 Accordingly, it is an object of the instant invention to provide a two-piece golf
9 ball that has a soft feel in combination with superior distance capabilities.

10 It is another object of the instant invention to optimize the combination of
11 core compression, core size, core composition, dimple configuration, cover
12 composition, and cover hardness to provide a two-piece golf ball, which travels great
13 distances, and at the same time complies with USGA regulations.

14 It is yet another object of the instant invention to provide a two-piece golf ball
15 having a synthetic cover material that achieves the sound, feel, playability and flight
16 performance qualities of balata covered golf balls.

17 It is a further object of the instant invention to lower the cost of manufacturing
18 a two-piece golf ball that has a soft feel in combination with superior distance
19 capabilities.

1 It is still a further object of the instant invention is to provide a two-piece golf
2 ball having superior distance, trajectory and flight stability.

3 Another object of the instant invention is to provide a two-piece golf ball having
4 a surface divided into a plurality of polygonal configurations or shapes for the location
5 of dimples for enhancing the aerodynamic properties of the golf ball.

6

7

SUMMARY OF THE INVENTION

8 The invention achieves the above-described objectives by providing a two-piece
9 golf ball having a solid rubber core, a synthetic ionomer resin cover, and a
10 "rhombicosadodecahedron" dimple pattern. The ball of the instant invention has a
11 core compression in the range of 77 PGA to 87 PGA; a core diameter in the range of
12 about 1.535 inches to about 1.545 inches; a cover hardness in the range of about 53
13 Shore D to about 59 Shore D, and a dimple pattern based on the geometry of a
14 rhombicosadodecahedron. This combination has been found to produce a ball with
15 superior distance capabilities, which also satisfies USGA regulations. The use of
16 these properties in the golf ball of the instant invention is based on the recognition
17 that it is the combination of the core compression, core composition, core size, cover
18 composition, cover hardness, dimple configuration, dimple size and dimple shape that

1 will produce a ball that will travel the greatest distance without compromising shot-
2 making feel.

3
4 The cover material can be constructed from any relatively stiff material, for
5 example, synthetic thermoplastic materials. Most notably these synthetic
6 thermoplastic materials are ionomeric resins. Ionomeric resins are polymers
7 containing interchain ionic bonding. As is well known in the chemical arts, ionomeric
8 resins are generally ionic copolymers of an olefin having from about two to about
9 eight carbon atoms, such as ethylene and a metal salt of an unsaturated carboxylic
10 acid, such as acrylic acid, methacrylic acid, or maleic acid. The pendent ionic groups
11 in the ionomeric resins interact to form ion-rich aggregates contained in a non-polar
12 polymer matrix. Metal ions, such as sodium, zinc or magnesium are used to
13 neutralize some portion of the acidic groups in the copolymer. This results in a
14 thermoplastic elastomer, which exhibits enhanced flight characteristics and
15 durability when compared to golf balls constructed with balata covers. However, the
16 advantages gained by enhanced durability have been offset by the decreased
17 playability properties.

18 The ionomers used in the cover composition are sold by E.I. Dupont De
19 Nemours & Company under the name SURLYN. In an attempt to overcome the

1 negative factors of the hard ionomer covers, DuPont introduced low modulus
2 SURLYN ionomers in the early 1980's. These SURLYN ionomers have a flexural
3 modulus of from about 3000 to about 7000 PSI and hardness of from 25 to about 40
4 as measured on the Shore D scale - ASTM 2240. The low modulus ionomers are
5 terpolymers, typically of ethylene, methacrylic acid and n- or iso-butylacrylate,
6 neutralized with sodium, zinc, magnesium or lithium cations. E.I. DuPont De
7 Nemours & Company has disclosed that the low modulus ionomers can be blended
8 with other grades of previously commercialized ionomers of high flexural modulus
9 from about 30,000 to 55,000 PSI to produce balata-like properties. However, "soft"
10 blends, typically 52 Shore D and lower (balata-like hardness), are still prone to cut
11 and shear damage.

12 The low modulus ionomers when used without high flexural modulus blends
13 produce covers with very similar physical properties to those of balata, including
14 poor cut and shear resistance. Worse, wound balls with these covers tend to go
15 "out-of-round" quicker than wound balls with balata covers. Blending with hard
16 SURLYN ionomers was found to improve these properties.

17 It has now been discovered that a blend of very low modulus ionomers with an
18 associated low acid level with an improved flow ionomer containing a medium acid
19 level results in a golf ball cover with improved playability characteristics. For the

1 purposes of the SURLYN ionomer resin grade designations, a low acid level is
2 approximately 12% by weight, and a medium acid level is approximately 15% by
3 weight.

4 As mentioned previously, in addition to manipulating the core and cover
5 parameters in a golf ball, superior aerodynamic properties are also attributed to the
6 dimple configuration on a golf ball. In the instant invention, the dimples are
7 arranged on the surface of the golf ball based on the geometry of a
8 rhombicosadodecahedron. This configuration is achieved by dividing the outer
9 spherical surface of a golf ball into a plurality of polygonal configurations, including
10 pentagons, squares and triangles for locating a plurality of dimples on the outer
11 surface of the golf ball. The polygonal configurations of this invention are preferably
12 a combination of regular pentagons, squares and triangles to cover the outer surface.
13 This first plurality of polygonal configurations is generally referred to herein as a
14 "rhombicosadodecahedron". The rhombicosadodecahedron is further characterized by
15 a uniform pattern of pentagons formed over the outer surface each bounded by
16 triangles and squares.

17 A pair of first polygonal configurations, each located on opposite sides of the
18 outer surface, include one of the two poles symmetrically arranged within its
19 boundaries. The outer surface has a plurality of dimples of different sizes. In one

1 embodiment, the dimples are of first, second and third sizes and are generally located
2 to have a first pattern associated with the pentagons, a second pattern associated
3 with the squares, and a third pattern associated with the triangles. Dimples are
4 preferably circular in shape, but can have a non-circular shape within the scope of
5 this invention.

6 The combination of the aforementioned core, cover and dimple specifications
7 produces a golf ball that possesses noticeable improvements in playability (i.e. spin
8 properties) without sacrificing the ball's durability (i.e. impact resistance etc.) which
9 in turn relates directly to the distance a ball will travel when struck. In addition, the
10 instant invention provides a golf ball composition that exhibits the desired properties
11 of the three-piece wound ball (e.g. long distance in combination with a soft feel), but
12 with the lower manufacture cost associated with the two-piece ball. These and other
13 objects of the instant invention will be apparent from a reading of the following
14 detailed description of the instant invention.

16 BRIEF DESCRIPTION OF THE DRAWING

17 Figure 1 is a sectional view of a golf ball made in accordance with one
18 embodiment of the invention.

1 Figure 2 is an elevation view of the outer surface of a golf ball being divided
2 into a plurality of polygonal configurations according to the invention.

3 Figure 3 is an elevation view of the golf ball of this invention showing the
4 relative locations of pentagons, squares, and triangles formed on the outer surface
5 with a pole at the center of a pentagon.

6 Figure 4 is an elevation view of the golf ball of this invention showing the
7 relative locations of pentagons, squares and triangles formed on the outer surface
8 with a pole at the center of a square.

9 Figure 5 is an equatorial view of the ball of preferred embodiment of the
10 instant invention.

11 Figure 6 is a polar view of the ball shown in Fig. 4.

12 Figure 7 is an equatorial view of the ball shown in Fig. 4, and includes the
13 polygons projected thereon.

14 Figure 8 is a polar view of the ball shown in Fig. 5 and include polygons
15 projected thereon.

16 Figure 9 is a cross sectional view cut through one of the dimples on the outer
17 surface of the ball.

18
19 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

1 Fig. 1 shows a section view of a two-piece golf ball made in accordance with the
2 preferred embodiment of the instant invention. A two-piece golf ball has a solid
3 rubber core 2 and a cover 4. The solid rubber core 2 is manufactured by using
4 conventional compression molding processes. The components are mixed together
5 and extruded to form preforms, which are then placed in cavities in the mold and are
6 compression molded under pressure and cured/vulcanized to form cores. The same
7 mix may also be injection molded. Curing is carried out in the mold at temperatures
8 of 280-380 degrees F for five to twenty minutes depending on the compound. Once
9 fully cured, the cores are removed from the mold cavities and prepared for
10 application of a cover.

11 In the preferred embodiment, the golf ball core 2 is made of a solid rubber
12 composition comprising a polybutadiene rubber center of a composition typical to the
13 industry. Specifically, the rubber may be 90-100 PHR polybutadiene, 0-10 PHR
14 polyisoprene, 20-35 PHR zinc diacrylate, 3-10 PHR zinc oxide, 0-30 PHR fillers,
15 process aids and antioxidants, and 0.5-5 PHR peroxide initiator. In the preferred
16 embodiment, the diameter of the solid rubber core 2 is about 1.540 ± 0.005 ". The core
17 2 weighs about 36.75 ± 0.25 grams, and has a compression of about 82 ± 5 PGA:

18 As is well known in the art, the type and amount of crosslinking agents used
19 to make the core will have the greatest influence on the core compression achieved.

1 To prepare the core 2 according to the preferred embodiment, it has been found that
2 a core composed primarily of high-cis polybutadiene in combination with cross-
3 linking agents, activators, initiators and fillers (active and inactive), can be used to
4 achieve a golf ball core having the desired compression characteristics. As used
5 herein, high-cis means a cis isomer content of greater than 93%. It is to be
6 understood that the core formula set forth herein is but one formula that can be
7 used to make a core having the desired core compression.

8 Once formed, the solid rubber core 2 is then subjected to a conventional
9 molding process whereby the SURLYN cover 4 is injection molded around the core 2
10 in a manner well known to those skilled in the art. To make the cover, the blended
11 components of the cover are injection molded into cavities, which contain cores
12 suspended in the center of the cavities. The inner surfaces of the cavities are
13 constructed with dimple-shaped projections, which form the dimples in the cover.
14 The process used to make the cover is the standard process used and well known in
15 the art wherein one or more components are added together to form a blend which
16 is then injected into the mold. After molding, the golf balls produced may undergo
17 further processing steps such as pressure blasting, vibratory finishing, stamping of
18 the logo, application of a primer, and finally, application of a top coat.

1 In the preferred embodiment, the cover has a thickness of about 0.070" leading
2 to provide a total diameter of core and cover of 1.680", the commercial ball diameter
3 standard specified by the United States Golf Association.

4 As discussed previously, the cover material is comprised of ionomer resins
5 available from E.I. du Pont de Nemours & Co. under the name SURLYN. In the
6 preferred embodiment, the ionomers are 66% by weight of SURLYN 6320 and 34% by
7 weight of SURLYN 8945. The hardness of the cover is about 56 ± 3 Shore D.

8 Under the Dupont SURLYN resin classification system, the 6320 SURLYN
9 ionomer is a soft ionomer. This very low modulus ionomer uses the Magnesium metal
10 ion to neutralize the acid groups, and its acid level is about 12% by weight. Moreover,
11 the 6320 SURLYN grade employs the terpolymer, n-butyl acrylate. Finally, the 6320
12 SURLYN resin has a melt index of about 1.1.

13 The 8945 SURLYN resin is classified as an improved-flow ionomer which has a
14 medium acid level of about 15 % by weight, which in turn produces a resin
15 characterized by a medium stiffness level. The 8945 SURLYN resin uses the sodium
16 ion to neutralize the acid groups, and it does not employ a terpolymer. Finally, the
17 8945 SURLYN resin has a melt index of about 4.0.

1 In addition to the SURLYN resins, the cover composition contains color
2 concentrate for coloring the golf ball in an amount well known to those skilled in the
3 art.

4 Turning now to the dimple technology employed in the instant invention, as
5 stated previously, the preferred geometry is a rhombicosadodecahedron. Accordingly,
6 the scope of this invention provides a golf ball mold whose molding surface contains a
7 uniform pattern to give the golf ball a dimple configuration superior to those of the
8 art. The invention is preferably described in terms of the golf ball that results from
9 the mold, but could be described within the scope of this invention in terms of the
10 mold structure that produces a golf ball.

11 To assist in locating the dimples on the golf ball, the golf ball of this invention
12 has its outer spherical surface partitioned by the projection of a plurality of polygonal
13 configurations onto the outer surface. That is, the formation or division that results
14 from a particular arrangement of different polygons on the outer surface of a golf ball
15 is referred to herein as a "plurality of polygonal configurations." A view of one side of
16 a golf ball 5 showing a preferred division of the golf ball's outer surface 7 is illustrated
17 in Fig. 2.

18 In the preferred embodiment, a polygonal configuration known as a
19 rhombicosadodecahedron is projected onto the surface of a sphere. A

1 rhombicosadodecahedron is a type of polyhedron which contains thirty (30) squares,
2 twenty (20) polyhedra of one type, and twelve (12) polyhedra of another type. The
3 term "rhombicosadodecahedron" is derived from "dodecahedron," meaning a twelve
4 (12) sided polyhedron; "icosahedron," meaning a twenty (20) sided polyhedron, and
5 "rhombus" meaning a four sided polyhedron.

6 The rhombicosadodecahedron of the preferred embodiment is comprised of
7 thirty (30) squares 12, twelve (12) pentagons 10, and twenty (20) triangles 14. It has
8 a uniform pattern of pentagons with each pentagon bounded by triangles and
9 squares. The uniform pattern is achieved when each regular pentagon 10 has only
10 regular squares 12 adjacent to its five boundary lines, and when a regular triangle 14
11 extends from each of the five vertices of the pentagon. Five (5) squares 12 and five (5)
12 triangles 14 form a set of polygons around each pentagon. Two boundary lines of each
13 square are common with two pentagon boundary lines, and each triangle has its
14 vertices common with three pentagon vertices.

15 The outer surface of the ball is further defined by a pair of poles and an
16 uninterrupted equatorial great circle path around the surface. A great circle path is
17 defined by the intersection between the spherical surface and a plane which passes
18 through the center of the sphere. Although an infinite number of great circle paths
19 may be drawn on any sphere, there is only one uninterrupted great circle path, which

1 corresponds to a mold parting line, and which gives the ball enhanced aerodynamic
2 properties as well as enhanced symmetry. The uninterrupted great circle path is
3 uninterrupted as a result of being free of dimples. The uninterrupted equatorial
4 great circle path in the preferred embodiment corresponds to a mold parting line,
5 which separates the golf ball into two hemispheres. The mold parting line is located
6 from the poles in substantially the same manner as the equator of the earth is located
7 from the north and south poles.

8 Referring to Fig. 3, the poles 70 are located at the center of a pentagon 10 on
9 the top and bottom sides of the ball, as illustrated in this view of one such side. The
10 mold parting line 30 is at the outer edge of the circle in this planar view of the golf
11 ball. In the embodiment shown in Fig. 4, the poles 72 are both located at the center of
12 the square on the top and bottom of the golf ball, as illustrated in this view of one
13 such side. (The top and bottom views are identical.) The mold parting line 40 is at the
14 outer edge of the circle in this planar view of the golf ball.

15 Dimples are placed on the outer surface of the golf ball based on segments of
16 the plurality of polygonal configurations described above. In the preferred
17 embodiment, three (3) dimples are associated with each triangle, five (5) dimples are
18 associated with each square, and sixteen (16) dimples are associated with each

1 pentagon. The term "associated" as used herein in relation to the dimples and the
2 polyhedra means that the polyhedra are used as a guide for placing the dimples.

3 In the preferred embodiment, there are a total of 402 dimples.
4 Advantageously, this decrease in the number of dimples when compared to prior art
5 golf balls results in a geometrical configuration that contributes to the aerodynamic
6 stability of the instant golf ball. Aerodynamic stability is reflected in greater control
7 over the movement of the instant golf ball.

8 The dimple configuration of the preferred embodiment is shown in Figs. 5-8. It
9 is based on the projection of the rhombicosadodecahedron shown in Fig. 3. The ball
10 has a total of 402 dimples. The plurality of dimples on the surface of the ball are
11 selected from three sets of dimples, with each set having different sized dimples.
12 Dimples 200 are in the first set, dimples 202 are in the second set, and dimples 204
13 are in the third set. Dimples are selected from all three sets to form a first pattern
14 associated with the pentagon 10. All sides 206 of each pentagon are intersected by
15 two dimples 200 from the first set of dimples and one dimple 202 from the second set
16 of dimples. All pentagons 10 have the same general first pattern arrangement of
17 dimples.

18 Dimples 200, 202 and 204 (from all three sets of dimples) are also used to form
19 a second pattern associated with the squares 12. All sides 208 of each square 12 are

1 intersected by dimples 202 from the second set of dimples, and all squares have the
2 same general second pattern arrangement of dimples.

3 Dimples 202 from the second set of dimples form a third pattern associated
4 with the triangles 14. All sides 210 of each triangle are intersected by a dimple 202
5 from this second set of dimples. All triangles have this same general third pattern
6 arrangement of dimples. The mold parting line 30 is the only dimple free great circle
7 path on this ball.

8 Advantageously, the use of a single uninterrupted mold parting line leads to
9 superior aerodynamic properties in the instant golf ball. The single mold parting line
10 results in less severe separation between the dimples, i.e. fewer "bald spots" on the
11 surface of the ball. This in turn increases the effectiveness of the dimples on the golf
12 ball. Advantageously, increasing the effectiveness of the dimples by reducing the
13 land area on the surface of the golf ball improves the aerodynamic properties of the
14 instant golf ball with regard to distance and control.

15 A major radius (Radius 1) describes the bottom of the dimple (i.e. it governs
16 the shape of the dimple toward the bottom of the dimple). A minor radius (Radius 2)
17 governs the shape of the dimple about its circumference. As noted below, in some
18 embodiments, these radii may be equal.

1 Dimple size is measured by a diameter and depth generally according to the
2 teachings of U.S. Patent No. 4,936,587 (the '587 patent), which is included herein by
3 reference thereto. An exception to the teaching of the '587 patent is the measurement
4 of the depth, which is discussed below. A cross-sectional view through a typical
5 dimple 6 is illustrated in Fig. 9. The diameter Dd used herein is defined as the
6 distance from edge E to edge F of the dimple. Edges are constructed in this cross-
7 sectional view of the dimple by having a periphery 50 and a continuation thereof 51 of
8 the dimple 6. The periphery and its continuation are substantially a smooth surface
9 of a sphere. An arc 52 is inset about 0.003 inches below curve 50-51-50 and intersects
10 the dimple at point E' and F'. Tangents 53 and 53' are tangent to the dimple 6 at
11 points E' and F' respectively and intersect periphery continuation 51 at edges E and F
12 respectively. The exception to the teaching of '587 noted above is that the depth d is
13 defined herein to be the distance from the chord 55 between edges E and F of the
14 dimple 6 to the deepest part of the dimple cross sectional surface 6 (a), rather than a
15 continuation of the periphery 51 of an outer surface 50 of the golf ball.

16 In the preferred embodiment, dimples 200 from the first set have a diameter of
17 0.156 inches; dimples 202 from the second set have a diameter of 0.145 inches, and
18 dimples 204 from the third set have a diameter of 0.140 inches. All dimples, 200, 202
19 and 204 have a depth of .0061 inches, and they are dual radius in cross section (i.e.

1 dual radius dimples), which means that there is a major radius (radius 1) describing
2 the bottom of the dimple, and a minor radius (radius 2) describing the side radius of
3 the dimple.

4 Advantageously, the use of dimples that are dual radius in cross section
5 improves the performance of the instant golf ball with respect to both distance and
6 control of the movement of the golf ball. The presence of dual radius dimples allows
7 for a soft trajectory in golf ball's flight. In turn, this soft trajectory leads to a soft
8 entry of the golf ball onto the golf course green, which in turn results in greater
9 control over the movement of the instant golf ball.

10 The major radius (radius 1) for all of the dimples in the preferred embodiment
11 is .7874 inches, and the minor radius (radius 2) for all of the dimples is .1181 inches.
12 However, it is understood that the following dimple size ranges are within the scope
13 of this invention. Dimples 200 from the first set may have a diameter in the range of
14 0.154 inches to 0.158 inches; dimples 202 from the second set may have a diameter in
15 the range of 0.145 to 0.148 inches; dimples 204 from the third set may have a
16 diameter in the range of 0.13 to 0.14 inches; all dimples, 200, 202 and 204 may have a
17 depth in the range of 0.0054 inches to 0.0064 inches; the major radius may be in the
18 range of 0.75 to 0.80 inches; and the minor radius may be in the range of 0.10 inches
19 to 0.12 inches. In some cases, the major radius may be equal to the minor radius.

1 The following examples are provided to illustrate and further explain the
2 beneficial effects of the ball described above. These examples are set forth for the
3 purposes of illustrating the advantages obtained with the combination of the core
4 compression, core size, cover composition, cover hardness, cover thickness, dimple
5 configuration, and dimple number that will produce a ball that will travel the
6 greatest distance without compromising shot-making feel.

EXAMPLE 1

The following table summarizes key features of the control and test samples.

XS Tour Golf Ball	Elastic Core Golf Ball
Core Data: Diameter (inches) 1.509 ± 0.005" Weight (grams) 34.75 ± 0.45 g Compression (PGA) 82 ± 7 PGA	Core Data: Diameter (inches) 1.540 ± 0.005" Weight (grams) 36.75 ± 0.25 g Compression (PGA) 82 ± 5 PGA
Cover Data: Thickness (inches) 0.085" Hardness (Shore D) 60 ±3 Shore D Composition (% by weight) 40 % Surlyn®8150 60 % Surlyn® 9320 W plus color concentrate	Cover Data: Thickness (inches) 0.070" Hardness (Shore D) 56 ±3 Shore D Composition (% by weight) 66 % Surlyn®6320 34 % Surlyn® 8945 plus color concentrate
Dimple Data: Geometrical Layout: Icosadodecahedron Total Number of Dimples: 432 Number of Uninterrupted Parting Lines: Several	Dimple Data: Geometrical Layout: Rhombicosadodecahedron Total Number of Dimples: 402 Number of Uninterrupted Parting Lines: One

Flight tests were conducted comparing the flight characteristics and the spin rate of two samples of the instant invention -i.e. the Elastic Core Golf Ball with a control sample, the XS Tour Golf Ball.

Example 1

Ball	Driver Carry (yards) Total (yards) Spin (rpm)	8-Iron Carry (yards) Total (yards) Spin (rpm)
Elastic Core Sample 1	235.5 256.8 2990	136.1 6997
Elastic Core Sample 2	235.8 257.4 2955	135.6 7071
XS Tour Golf Ball	227.9 252.4 2856	135.8 6923

Advantageously, as is clearly demonstrated by the test results, the use of a golf ball configured according to the aforementioned core, cover and dimple parameters results in a golf ball, the Elastic Core, which has longer flight characteristics and a higher spin rate than the control sample.

It will be appreciated that the instant specification and claims are set forth by way of illustration and do not depart from the spirit and scope of the instant invention. It is to be understood that the instant invention is by no means limited to the particular embodiments herein disclosed, but also comprises any modifications or equivalents within the scope of the claims.

1 Having thus described my invention, what I claim as new and desire to secure
2 by United States Letters Patent is:

3
4

- 1 1. A two-piece golf ball comprising
2 a core having a compression in the range of about 77 PGA to about 87 PGA;
3 a cover having a Shore D hardness in the range of about 53 Shore D to about
4 59 Shore D; and
5 an outer surface divided into a plurality of polygonal configurations, which
6 include pentagons, squares and triangles; and
7 a plurality of dimples arranged on the outer surface, with a first pattern of
8 dimples associated with each triangle, a second pattern of dimples associated with
9 each pentagon, and a third pattern of dimples associated with each square.

10

- 11 2. The ball of claim 1 wherein the core has a diameter in the range of about 1.535
12 inches to about 1.545 inches.

13

- 14 3. The ball of claim 1 wherein the core has a weight in the range of about 36.50
15 grams to about 37.00 grams.

16

- 17 4. The ball of claim 1 wherein the cover has a composition comprising an ionomeric
18 resin plus color concentrate.

19

- 20 5. The ball of claim 1 wherein the cover has a thickness of about 0.070 inches.

- 1
- 2
- 3 6. The golf ball of claim 1 wherein said outer surface is divided into a polyhedron
- 4 defined as a rhombicosadodecahedron.
- 5
- 6 7. The golf ball of claim 1 wherein said dimples are dual radius in cross section.
- 7
- 8 8. The golf ball of claim 6 further comprising fifteen parting lines along great circle
- 9 paths for further dividing said outer surface, said parting lines combining to
- 10 essentially divide each pentagon into ten smaller triangles of equal size, each
- 11 triangle into six triangles of equal size and each square into four smaller
- 12 squares of equal size to obtain an outer surface consisting of smaller triangles
- 13 and squares.
- 14
- 15 9. The golf ball of claim 1 further comprising a first set of dimples, with each dimple
- 16 in the first set having a first size; a second set of dimples, with each dimple in the
- 17 second set having a second size; and a third set of dimples, with each dimple in
- 18 the third set having a third size, wherein the plurality of dimples are selected
- 19 from the first set of dimples, the second set of dimples, and the third set of
- 20 dimples.
- 21

1 10. The golf ball of claim 8 wherein sides of each pentagon are intersected by two
2 dimples from the first set of dimples and one dimple from the second set of
3 dimples.
4

5 11. The golf ball of claim 9 wherein sides of each square are intersected by at least
6 one dimple from the second set of dimples.
7

8 12. The golf ball of claim 9 wherein sides of each triangle are intersected by a dimple
9 from the second set of dimples.
10

11 13. The golf ball of claim 1 further comprising:

12 two poles,

13 an uninterrupted equatorial great circle path that is free of dimples and that
14 defines a mold line symmetrically positioned with respect to said two poles on said
15 outer surface; and

16 a pair of first polygonal configurations each being located on opposite sides of
17 said outer surface to include one of said two poles symmetrically arranged within its
18 boundaries.
19

20 14. The golf ball of claim 13 wherein said first polygonal configurations are
21 pentagons.

- 1
- 2 15. The golf ball of claim 13 wherein said first polygonal configurations are squares.
- 3
- 4 16. The golf ball of claim 13 wherein said uninterrupted equatorial great circle path
- 5 is not intersected by any dimples.
- 6
- 7 17. The golf ball of claim 1 wherein said dimples are essentially circular with each one
- 8 of said dimples having a size defined by a diameter in the range of about 0.13
- 9 inches to about 0.14 inches, and a depth in the range of about 0.0054 inches to
- 10 about 0.0064 inches.
- 11
- 12 18. The golf ball of claim 1 wherein the total number of dimples is at least 402.

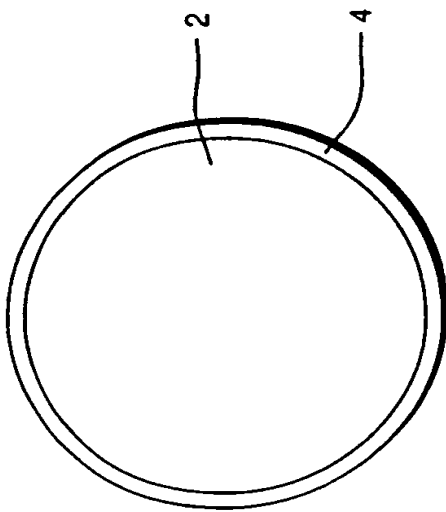


FIG. 1

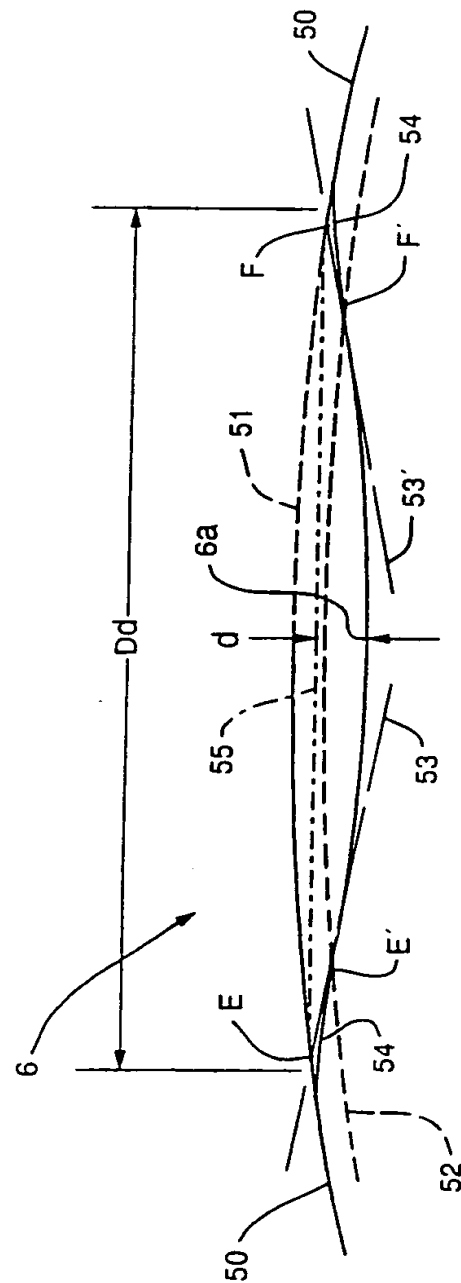


FIG. 9

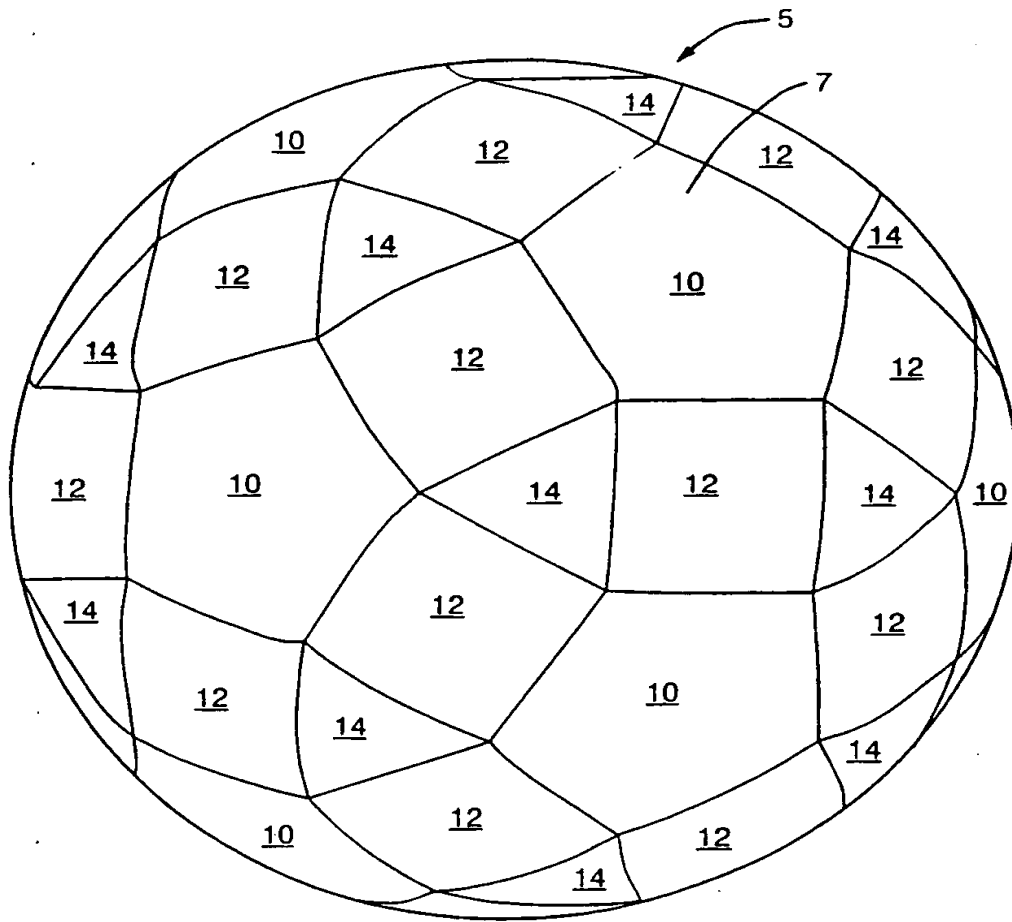


FIG. 2

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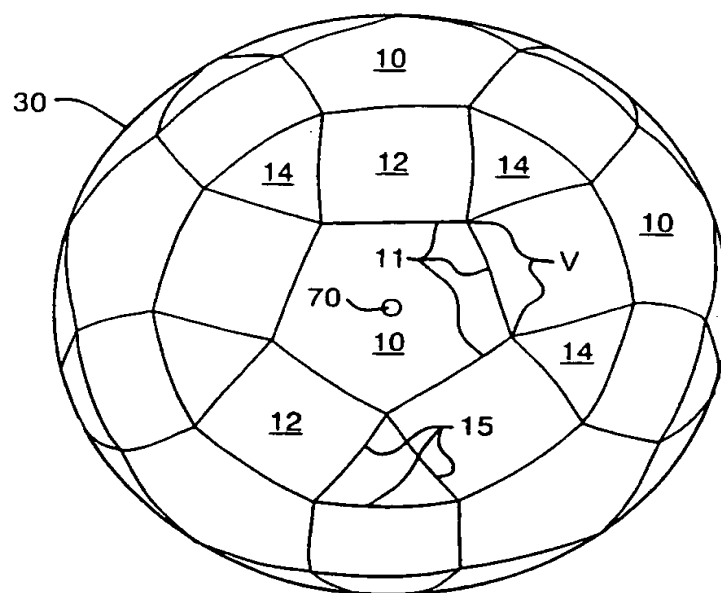


FIG. 3

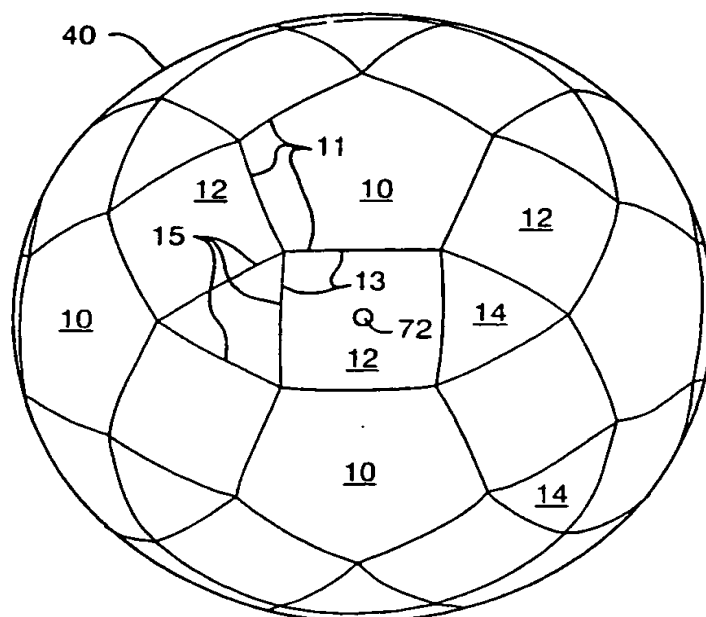


FIG. 4

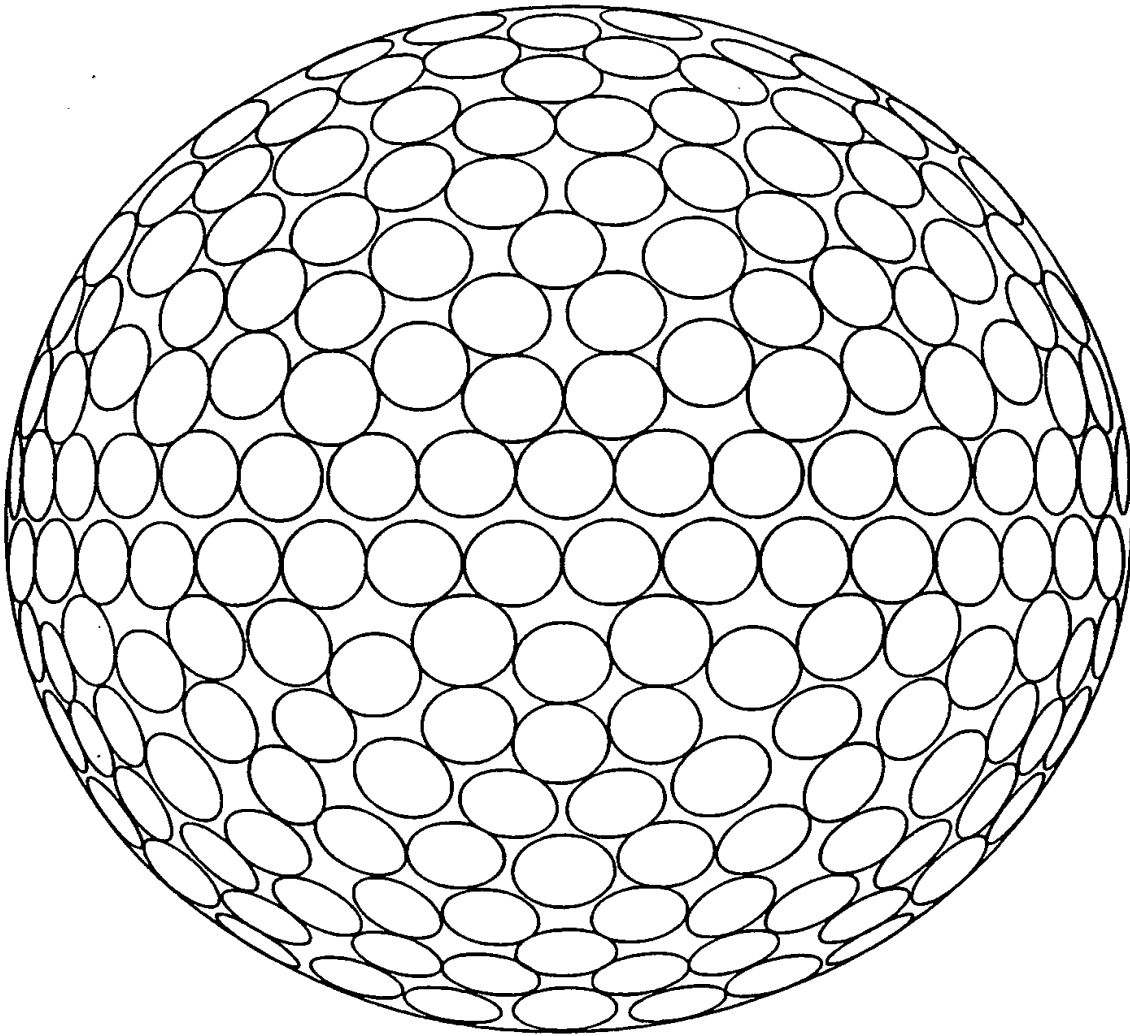


FIG. 5

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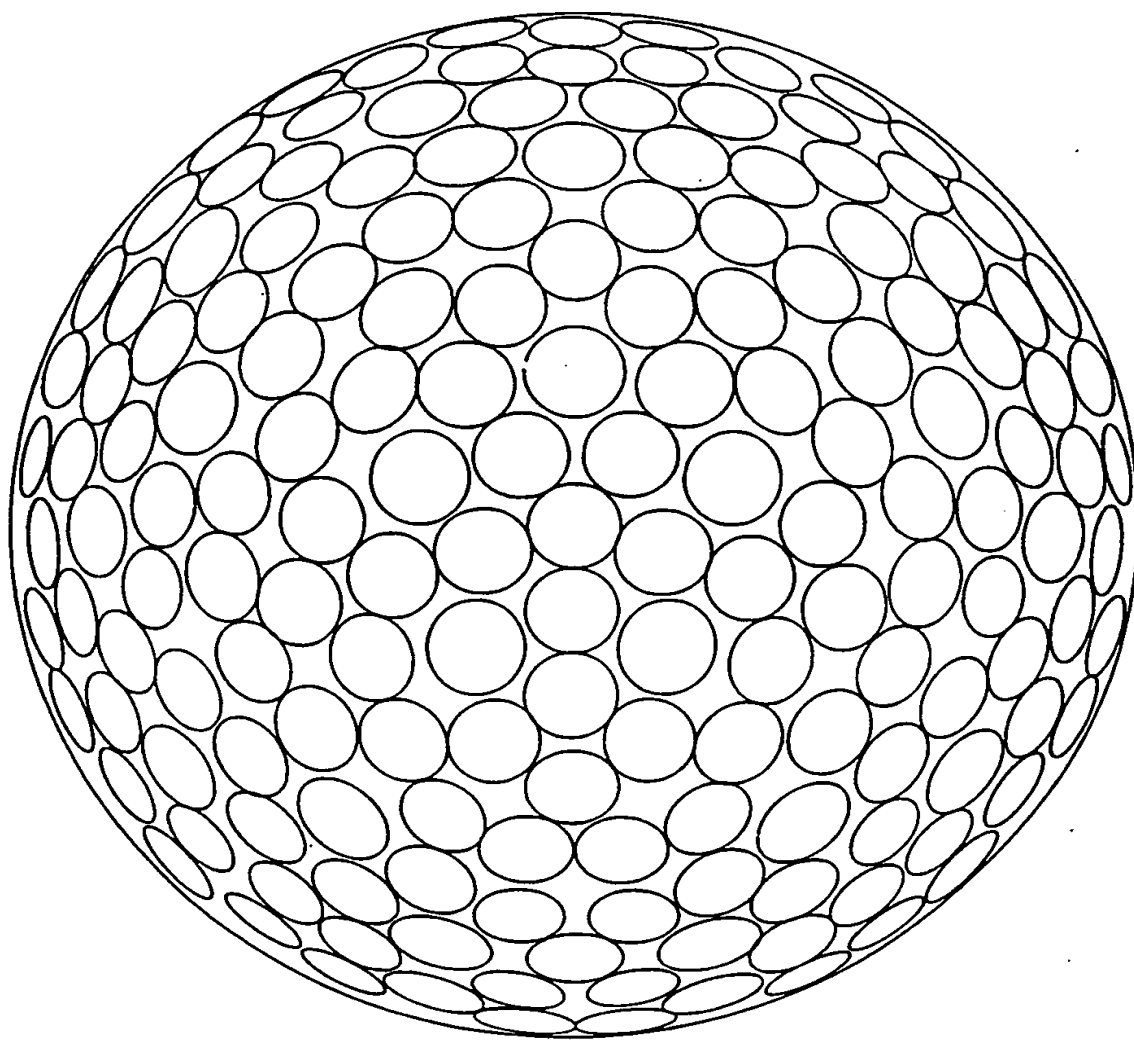


FIG. 6

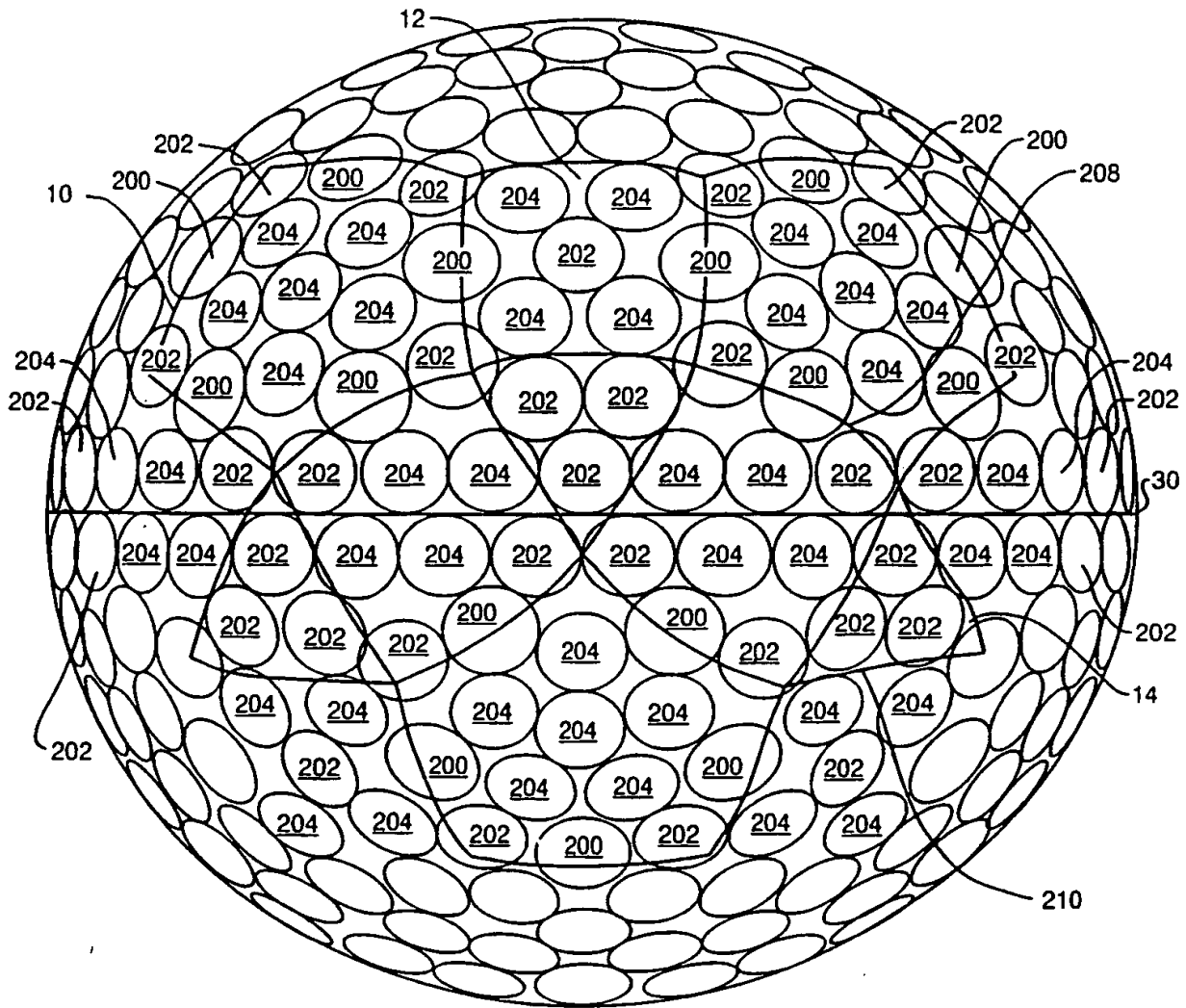


FIG. 7

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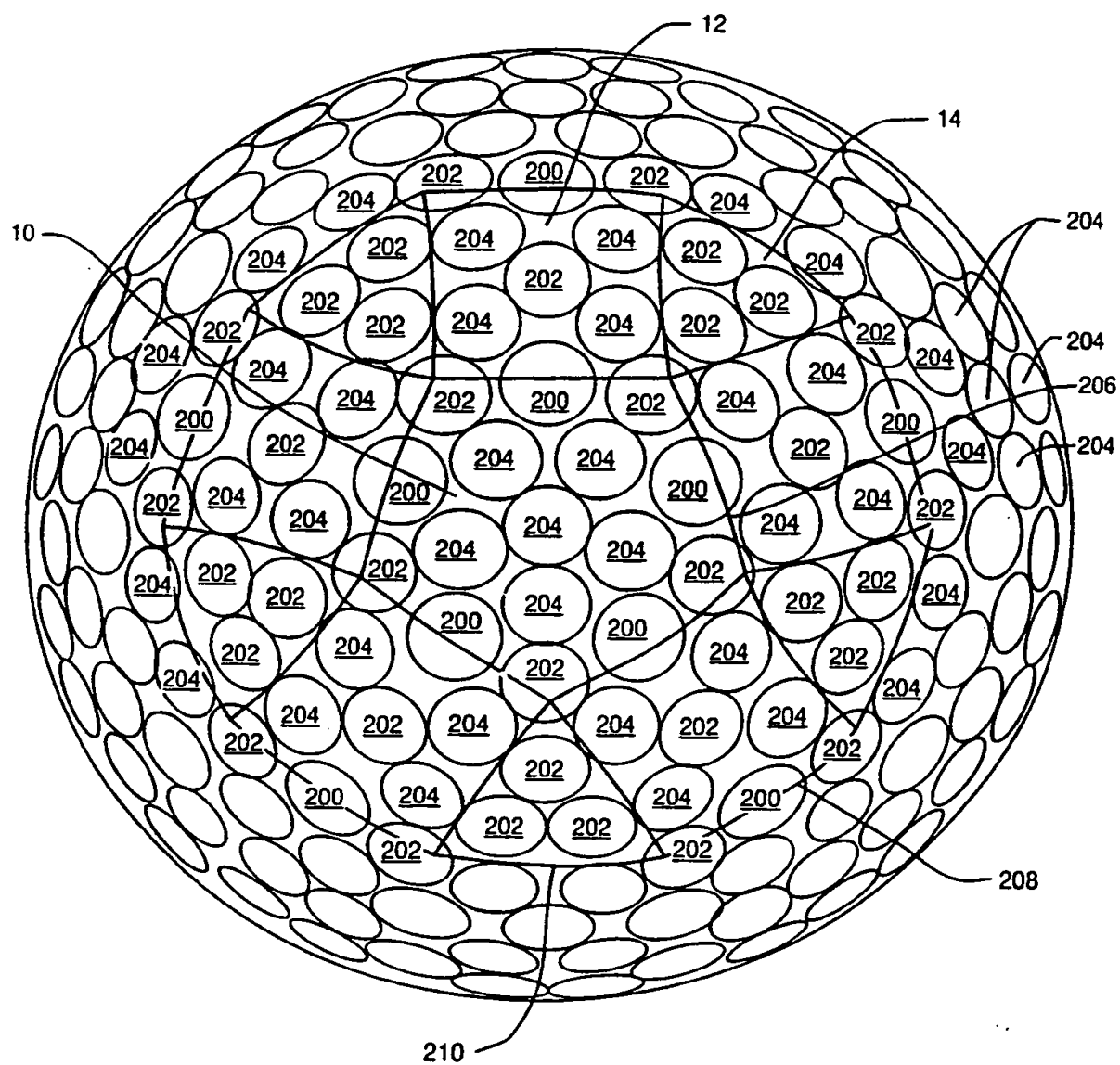


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/01062

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :A63B 37/12

US CL :473/381

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 473/381, 378, 379, 380, 382, 383

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,700,209 A (SUGIURA) 23 December 1997, See entire document.	1-18
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Y	US 5,709,618 A (HWANG) 20 January 1998, See entire document.	1-18
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

03 MARCH 2000

Date of mailing of the international search report

21 MAR 2000

Name and mailing address of the ISA/US
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Facsimile No. (703) 308-7768

Authorized officer

Jeanette Chapman

Telephone No.

(703) 308-1370

Sheila Vanev
Patent Specialist
Technology Center 3700



2280 HV Rijswijk (ZH) *
☎ +31 70 340 2040
TX 31651 epo nl
FAX +31 70 340 3016

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recherche

Torggler, Paul Norbert, Dr.
Patentanwälte Torggler & Hofinger
Wilhelm-Greil-Strasse 16
Postfach 556
6021 Innsbruck
AUTRICHE

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03. Nov. 2003
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Datum/Date

03.11.03

chen/Ref./Réf.

49712

Anmeldung Nr./Application No./Demande n°./Patent Nr./Patent No./Brevet n°.

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melder/Applicant/Demandeur/Patentinhaber/Proprietor/Titulaire

Dunlop Slazenger Group Americas Inc

COMMUNICATION

The European Patent Office herewith transmits as an enclosure the European search report for the above-mentioned European patent application.

If applicable, copies of the documents cited in the European search report are attached.

☐ Additional set(s) of copies of the documents cited in the European search report is (are) enclosed as well.

The following specifications given by the applicant have been approved by the Search Division:

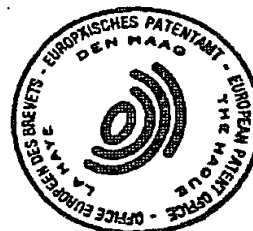
☒ abstract

☒ title

☐ The abstract was modified by the Search Division and the definitive text is attached to this communication.

The following figure will be published together with the abstract:

4



REFUND OF THE SEARCH FEE

If applicable under Article 10 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	* abstract * * page 7, line 10 - line 14 * * page 13, line 15 - line 17 * * page 15, line 1 - line 17 * * page 19, line 8 - page 20, line 7 * * page 21, line 16 - page 22, line 3; claims; example 1 * --- A & US 6 383 093 B1 (KUTTAPPA ET AL.) 7 May 2002 (2002-05-07) * figure 10 *	12	
Y	US 5 803 831 A (NEALON JOHN L ET AL) 8 September 1998 (1998-09-08)	1-3,7,8, 15,17, 18,20	
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	The present search report has been drawn up for all claims		
Place of search MUNICH		Date of completion of the search 23 October 2003	Examiner Lundblad, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 11 4649

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EP 01 11 4649

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